Central Intelligence Agency
Office of the Deputy Director for Science & Technology

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Micro-mang

more than 25 words

on manufacturing

in space.

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MATERIALS AND COMPONENT PROCESSING IN SPACE

Manufacturing or processing in a space station is only logical for those operations which can benefit from one or both of the two (2) conditions: a near-perfect, unlimited vacuum and a zero-gravity environment. Of these two the zero-gravity environment is the most difficult to achieve otherwise and thus of most significance. Processing in space or on earth is not so much a question of cost tradeoffs but whether an operation can be performed in space which otherwise could not be performed at all.

Without gravity, liquid and vapor phase materials are exceptionally homogeneous since both convective cooling effects and the concentration gradients produced by sedimentation are absent. Solidification of these materials can produce large, structuurally perfect crystals with accurately controlled and very uniform purities or concentrations of dopants. As examples; large and therefore sensitive Mercuric-Iodide gamma detectors, solar cells near the limit of theoretical efficiency, and large area avalanche photo-diodes are possible with such crystals, which cannot be produced otherwise. In general these process and materials controls can enhance the performance and reliability of any semi-conductor device.

The separation and concentration of the large macro-molecules of biological materials which on earth is limited by sedimentation is facilitated by zero-gravity. Consequently space processing can yield quantities of medicines and biochemicals which are unobtainable by earth-based processing.

Notwithstanding the above, there is no obvious advantage in doing space processing for the complex and elaborate fabrication required in manufacture of micro-chips and integrated circuits. Given the above space-processed materials, final fabrication can most expeditiously and economically be done in terrestial facilities.

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Roy,

The suggested advantage of semi-conductor manufacture in space involves the crystal ingots which are the basic material from which integrated circuits are fabricated. Under zero gravity, these crystals would be grown with (it is thought) fewer imperfections. The reduction in imperfections would result in a higher yield rate for standard-sized circuits and could potentially allow fabrication of larger circuits with an acceptable yield rate. It is possible that it could be economical to accomplish this portion of the IC fabrication process in space. It is not clear if other steps in the process could economically take advantage of the zero gravity, high vacuum, or low temperatures of space.

Dom V.